WHAT IS CLAIMED IS:

1. A flow controller, comprising:

(a) a channel having

(i) a fluid inlet in liquid communication with a fluid source at pressure P1,

(ii) a fluid outlet at pressure P2, wherein P2 < P1, and

(iii) a porous dielectric material disposed in said channel;

(b) a fluid contained within said channel;

(c) spaced electrodes in electrical communication with said fluid;

(d) a power supply in electrical communication with said electrodes for applying an electric potential to said spaced electrodes,

whereby said electric potential generates an electroosmotically-driven flow component through said channel that modulates a pressure-driven flow component resulting from the P1 – P2 pressure differential.

2. The flow controller of claim 1, further comprising:

(e) a first flow element having a first flow element inlet in liquid communication at a first node at pressure PN with said fluid inlet and said fluid source, wherein P2 < PN, and a first flow element outlet at pressure P3, and

whereby the electroosmotically driven flow component affects the proportion of fluid flowing through said channel and said first flow element.

3. The flow controller of claim 2, further comprising:

(f) a second flow element interposed between said fluid source and said first node, said second flow element having a second flow element inlet in liquid communication with said fluid source, and a second flow element outlet in liquid communication at said first node with said fluid inlet and said first flow element inlet.

4. The flow controller of claim 1, wherein said power supply is a variable power supply.

5. The flow controller of claim 1, wherein said pressure-driven and said electroosmotically-driven flow components through said channel are in the same direction.

6. The flow controller of claim 1, wherein said pressure-driven and said electroosmotically-driven flow components through said channel are in the opposite direction and the pressure-driven fluid flux is greater than or equal to the electroosmotically driven fluid flux.

7. The flow controller of claim 1, wherein said electrical communication is through a bridge.

8. The flow controller of claim 1, wherein said channel has a circular cross-section.

9. The flow controller of claim 1, wherein said channel comprises a fused silica capillary.

10. The flow controller of claim 1, wherein the porous dielectric material includes silica particles.

11. The flow controller of claim 10, wherein the silica particles have a diameter of between about 100 nm and 5 µm.

12. The flow controller of claim 1, wherein the porous dielectric material includes porous dielectric materials fabricated by processes selected from the group consisting of lithographic patterning and etching, direct injection molding, sol-gel processing, and electroforming.

13. The flow controller of claim 1, wherein the porous dielectric material includes organic polymer materials.

14. The flow controller of claim 1, further comprising at least one sensor for monitoring at least one control signal, and a feedback control mechanism operatively connected to said sensor and said power supply, wherein said feedback control mechanisms maintains said at least one control signal within a predetermined range by modulating the electric potential applied by said power supply.

15. The flow controller of claim 14, wherein said at least one sensor is selected from the group consisting of a pressure transducer, a flowmeter, a temperature sensor, a heat flux sensor, a displacement sensor, a load cell, a strain gauge, a conductivity sensor, a selective ion sensor, a pH sensor, a flow spectrophotometer, and a turbidity sensor.

16. The flow controller of claim 15, wherein said at least one sensor is a pressure transducer.

17. The flow controller of claim 16, wherein said pressure transducer is a differential pressure transducer.

18. The flow controller of claim 15, wherein said at least one sensor is a flowmeter.

19. The flow controller of claim 2, further comprising at least one sensor that monitors at least one control signal, and a feedback control mechanism

operatively connected to said sensor and said first power supply, and wherein said feedback control mechanism maintains said at least one control signal within a predetermined range by adjusting the potential difference applied by said power supply.

20. The flow controller of claim 19, wherein said at least one sensor is selected from the group consisting of a pressure transducer, a flowmeter, a temperature sensor, a heat flux sensor, a displacement sensor, a load cell, a strain gauge, a conductivity sensor, a selective ion sensor, a pH sensor, a flow spectrophotometer, and a turbidity sensor.

21. The flow controller of claim 20, wherein said at least one sensor is a pressure transducer.

22. The flow controller of claim 21, wherein said pressure transducer is a differential pressure transducer.

23. The flow controller of claim 20, wherein said at least one sensor is a flowmeter.

24. The flow controller of claim 2, further comprising:

(f) a second channel having

(i) a second fluid inlet in liquid communication with a second fluid source, said second fluid source at pressure P4,

(ii) a second fluid outlet at pressure P5, wherein P5 <P4,

(iii) and a second porous dielectric material disposed in said second channel;

(g) a second fluid contained within said second channel;

(h) second spaced electrodes in electrical communication with said second fluid;

(i) a second power supply in electrical communication with said second spaced electrodes for applying a second electric potential to said second spaced electrodes,

whereby said second electric potential generates a second electroosmotically-driven flow component through said second channel that modulates a second pressure-driven flow component resulting from the P4 – P5 pressure differential;

(j) a third flow element having a third flow element inlet in liquid

communication at a second node at pressure PN_2 with said second fluid inlet and said second fluid source, wherein $P5 < PN_2$, and a third flow element outlet in liquid communication at a third node with said first flow element outlet at pressure P3, and

whereby said second electroosmotically driven flow affects the proportion of second fluid flowing through said second channel and said third flow element.

25. The flow controller of claim 24, further comprising:

(k) a fourth flow element interposed between said fluid source and said first node, said fourth flow element having a fourth flow element inlet in liquid communication with said fluid source, and a fourth flow element outlet in liquid communication at said first node with said fluid inlet and said first flow element inlet.

26. The flow controller of claim 25, further comprising:

(l) a fifth flow element interposed between said second fluid source and said second node, said fifth flow element having a fifth flow element inlet in liquid communication with said second fluid source, and a fifth flow element outlet in liquid communication at said second node with said second fluid inlet and said third flow element inlet.

27. The flow controller of claim 24, further comprising:

(k) a plurality of sensors that monitor a plurality of control signals;

(l) and a feedback control mechanism operatively connected to said sensors, and to said first and second power supplies,

wherein said feedback control mechanism maintains said plurality of control signals within predetermined ranges by controlling the electric potentials applied by said first and said second power supplies.

28. The flow controller of claim 27, wherein said plurality of sensors is selected from the group consisting of a pressure transducer, a flowmeter, a temperature sensor, a heat flux sensor, a displacement sensor, a load cell, a strain gauge, a conductivity sensor, a selective ion sensor, a pH sensor, a flow spectrophotometer, and a turbidity sensor.

29. The flow controller of claim 28, wherein at least one of said plurality of sensors is a pressure transducer.

30. The flow controller of claim 29, wherein said pressure transducer is a differential pressure transducer.

31. The flow controller of claim 28, wherein at least one of said plurality

of sensors is a flowmeter.

32. The flow controller of claim 27, wherein said feedback control mechanism is programmable.

33. The flow controller of claim 32, wherein said programmable feedback control mechanism maintains the sum of the fluid flowing through said first flow element outlet and said second flow element outlet within a predetermined range by monitoring a control signal originating at said third node, and adjusting the electric potentials applied by said first and said second power supplies.

34. The flow controller of claim 33, wherein said control signal originating at said third node is proportional to the pressure, P3.

35. The flow controller of claim 32, wherein said programmable feedback control mechanism maintains the relative amounts of fluid flowing from said first flow element outlet and said second flow element outlet within a predetermined range by monitoring control signals originating at said first node and said second node, and adjusting the electric potentials applied by said first and second power supplies.

36. The flow controller of claim 35, wherein said control signals originating at said first node and said second node are proportional to the pressures PN and PN_2.

37. A flow controller, comprising:

(a) a fluid source at pressure P1 in liquid communication with a node, said node at pressure PN;

(b) a first channel having

(i) a first fluid inlet in liquid communication with said node,

(ii) a first fluid outlet at pressure P2, wherein P2 < P1 and P2 < PN, said first fluid outlet in liquid communication with a first fluid reservoir, and

(iii) a first porous dielectric material disposed in said first channel;

(c) a second channel having

(i) a second fluid inlet in liquid communication with said node,

(ii) a second fluid outlet at pressure P2', wherein P2' < P1

and P2' < PN, said second fluid outlet in liquid communication with a second fluid reservoir, and

(iii) a second porous dielectric material disposed in said second channel;

(d) a fluid contained within said first channel and said second channel;

(e) a first flow element having a first flow element inlet in liquid communication at said node with said first fluid inlet, said second fluid inlet, and said fluid source, and a first flow element outlet;

(f) a first electrode in electrical communication with a first fluid reservoir fluid;

(g) a second electrode in electrical communication with a second fluid reservoir fluid;

(h) a power supply in electrical communication with said first and said second electrodes for applying an electric potential to said first and said second electrodes,

whereby said electric potential generates an electroosmotically-driven flow component through at least one of said first and said second channels that modulates at least one of the pressure-driven flow components resulting from the P1 – P2 and the P1 – P2' pressure differentials, and whereby the electroosmotically driven flow component affects the proportion of fluid throwing through said first flow element and at least one of said first channel and said second channel.

38. The flow controller of claim 37, further comprising:

(i) a second flow element interposed between said fluid source and said first node, said second flow element having a second flow element inlet in liquid communication with said fluid source, and a second flow element outlet in liquid communication at said node with said first fluid inlet, said second fluid inlet, and said first flow element inlet.

39. A method for controlling a flow of a fluid, comprising:

applying an electric potential to spaced electrodes in electrical communication with a fluid contained within a channel, said channel having a porous dielectric material disposed therein, said channel also having a fluid inlet in liquid communication with a fluid source at pressure P1, and a fluid outlet at pressure P2, wherein P2 <P1 and whereby said electric potential generates an electroosmotically-

driven flow component through said channel that modulates a pressure-driven flow component resulting from the P1 – P2 pressure differential.

40. A method for controlling a flow of a fluid, comprising:

applying an electric potential to spaced electrodes in electrical communication with a fluid contained within a channel, said channel having a porous dielectric material disposed therein, said channel also having a fluid inlet in liquid communication at a node at pressure PN with a fluid source at pressure P1 and a first flow element inlet, and a fluid outlet at pressure P2, wherein P2 < P1, and wherein P2 < PN, and whereby said electric potential generates an electroosmotically-driven flow component through said channel that affects the proportion of fluid flowing through said channel and said first flow element.